

PCB Source Investigation

for the

Development of the Roanoke River TMDL

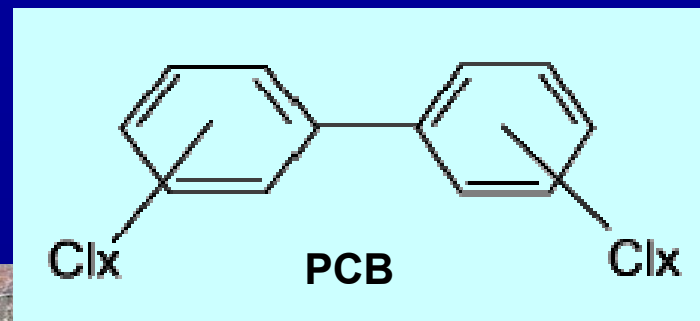
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Discussion Overview

- PCB Background
- Monitoring
- PCB Analysis
- Results
- PCB WQC vs. Site Specific Endpoints



What are PCBs?

- Biphenyl molecule (1-10 chlorine atoms)
- 209 distinct PCB Compounds – “Congeners”
- Total PCB (tPCB) = Summation of 209 Congeners (*Basis for VA WQC*)
- Aroclors – mixture of congeners
 - Aroclor 1248 is 48% chlorine



PCBs - Background



- Estimated that > 1.5 Billion lbs. manufactured in the U.S. until 1977
- Very stable and heat resistant
- Common uses:
 - Transformers, capacitors, hydraulic fluids, circuit breakers, PVC Products, carbonless copy paper, caulking material, etc.



PCBs – Current Releases?

- PCBs used many years after banned
- Contaminated sites with active transport
- Dielectric oils considered non PCB < 50 ppm
 - Fish advisories at 0.05 ppm
- Inadvertent production

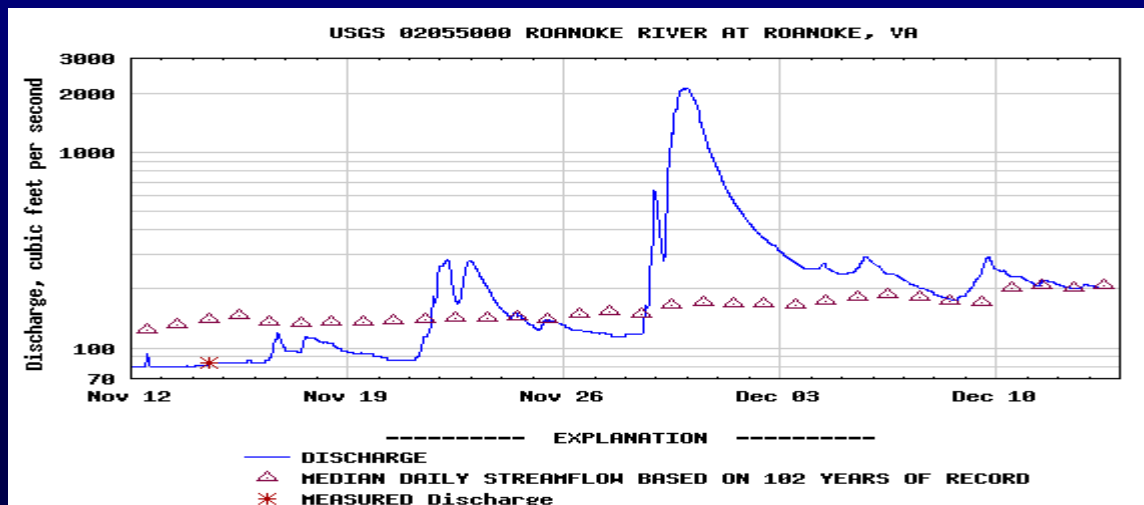


EPA Method 1668

- Performance based method
 - High Resolution GC/High Resolution MS
- Measures Tot. PCB - Congener-specific basis
 - Detection Level <5 pg/L (or 0.000005 ug/L)
 - Reporting Level < 10 pg/L
 - Levels are relevant to DEQ's WQC (640 pg/L)
- Used for the Delaware/Potomac River TMDLs
- Extensively used for the Roanoke (Staunton) River TMDL

Ambient PCB Monitoring Design

- PCB grab samples collected along with dissolved and total organic carbon and TSS
- Base (low) & high flow condition
- Accounts for event driven PCB loads



Monitoring Summary

- Round 1
 - Fall 2005
 - SPMDs (deployed 25 and retrieved 21)
 - Grab samples (low and high river flows)
 - Effluent (1 facil. in upper & 3 in lower)
 - Method 1668A used for Analysis
 - Analytical issue – significant correction due to background contamination
 - Results qualitative (??)
 - Revealed/confirmed source areas

Monitoring Summary

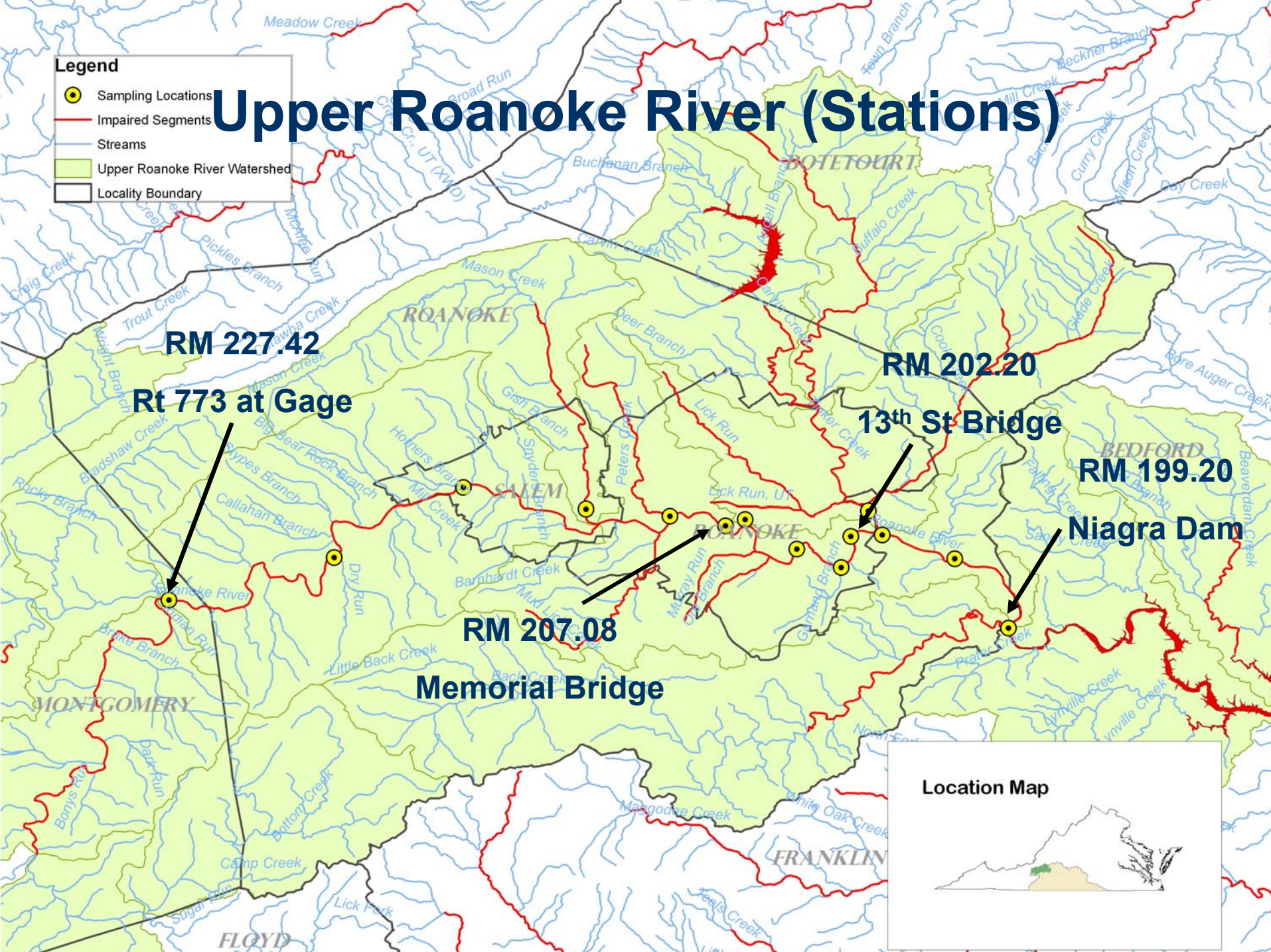
- Round 2
 - Fall 2007-Spring 2008
 - 46 water grab samples (low and high river flows)
 - Effluent (1 facil. in upper and 3 in lower)
 - Sediment (14 sediment/6 sludge)
 - Method 1668A used for Analysis
 - Collected larger volume (water)
 - » Lower Reporting Levels (~5 pg/L on a congener basis)
 - » Background minimized

Uses for PCB Data

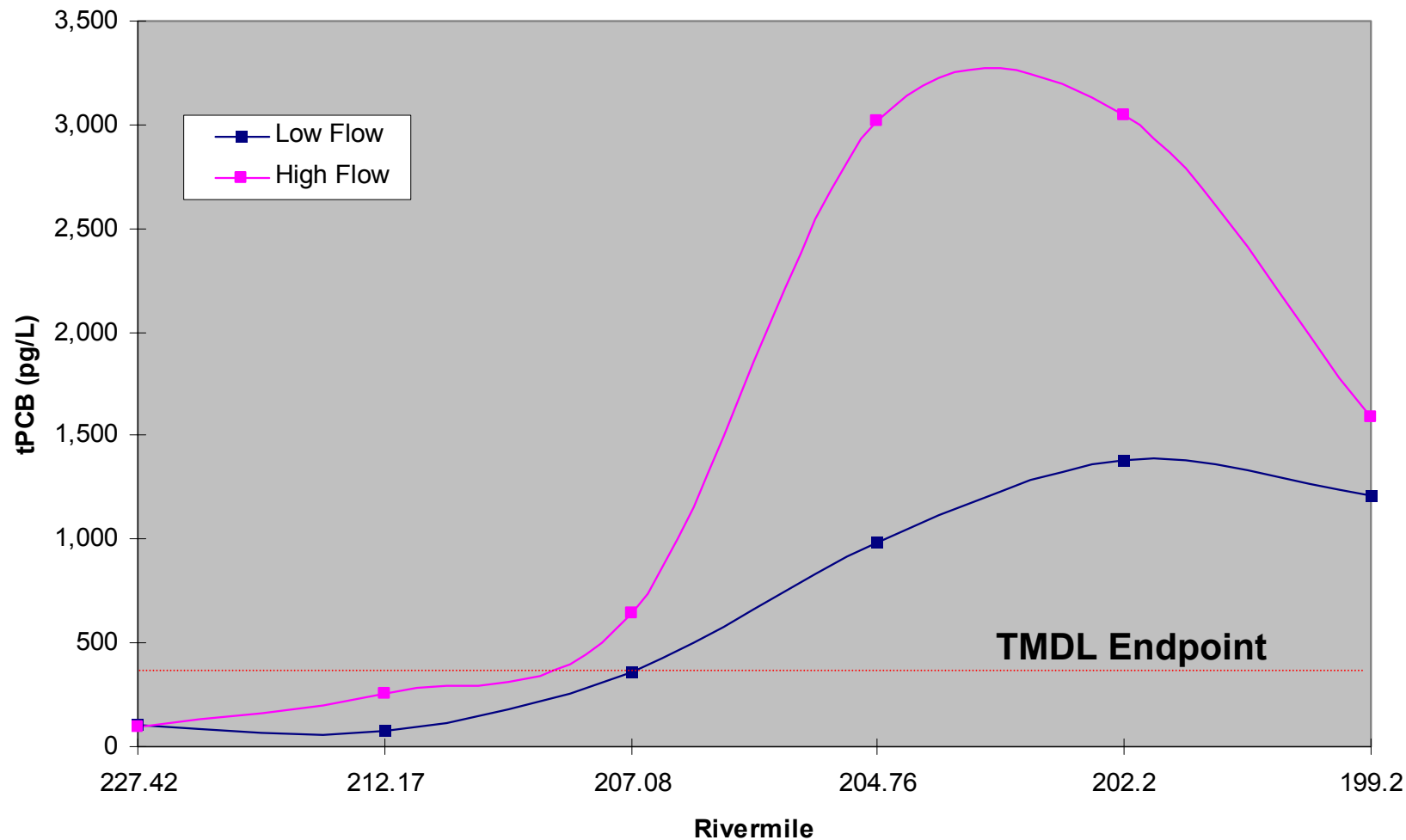
- PCB Source identification
 - Wastewater samples
 - Calculate PCB loadings
 - Ambient samples
 - Homolog groups and congeners help “fingerprint” sources
- Assist with TMDL model calibration & validation
- Used to develop PCB endpoint

Legend

- Sampling Locations
- Impaired Segments
- Streams
- Upper Roanoke River Watershed
- Locality Boundary



Total PCB concentrations (pg/L) in ambient water collected from the upper Roanoke River during low and high flows



Ambient Water PCB Results (Upper Roanoke River)

- Appears to be a low input of PCBs above Roanoke
- Increased PCB loading occurs upstream from RM 207.08
- With the exception of RM 227.42, PCB concentrations during high flows can be 2-3X higher than those observed during base flow

Water Quality Criterion = 640 pg/L
Proposed Endpoint = 360 pg/L

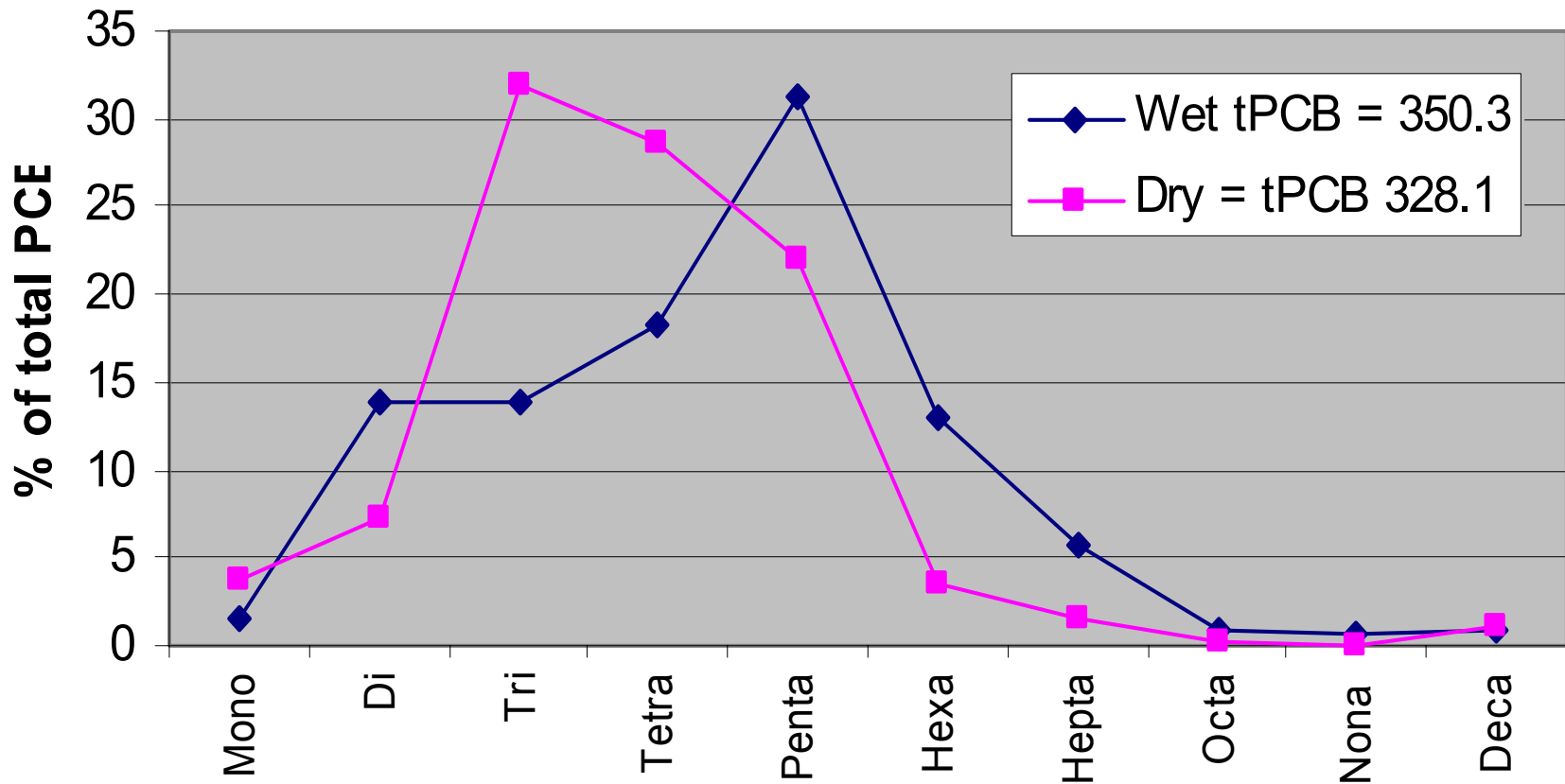
Ambient Data

Ambient Location	Sample Date	Flow Condition	Total PCB (pg/L) *Blank adj	Sample Date	Flow Condition	Total PCB (pg/L) *Blank adj
Upper Roanoke						
4AROA227.42 (Rt 773 at Gage)	3/3/08	Low	107	4/7/08	High	95
4AROA212.17 (419 Brdg)	3/3/08	Low	80	4/7/08	High	256
4AROA207.08 (Memorial Brdg)	3/3/08	Low	363	4/7/08	High	642
4AROA204.76 (Walnut Ave. Brdg)	3/3/08	Low	987	4/7/08	High	3,014
4AROA202.20 (13 th St. Brdg)	3/3/08	Low	1,376	4/7/08	High	3,044
4AROA199.20 (Below Niagra Dam)	3/3/08	Low	1,213	4/7/08	High	1,588
4AGND000.02 Below Riverland Rd	3/3/08	Low	155	4/7/08	High	613
Above Steel Dynamics	3/3/08	Low	751		No Data	

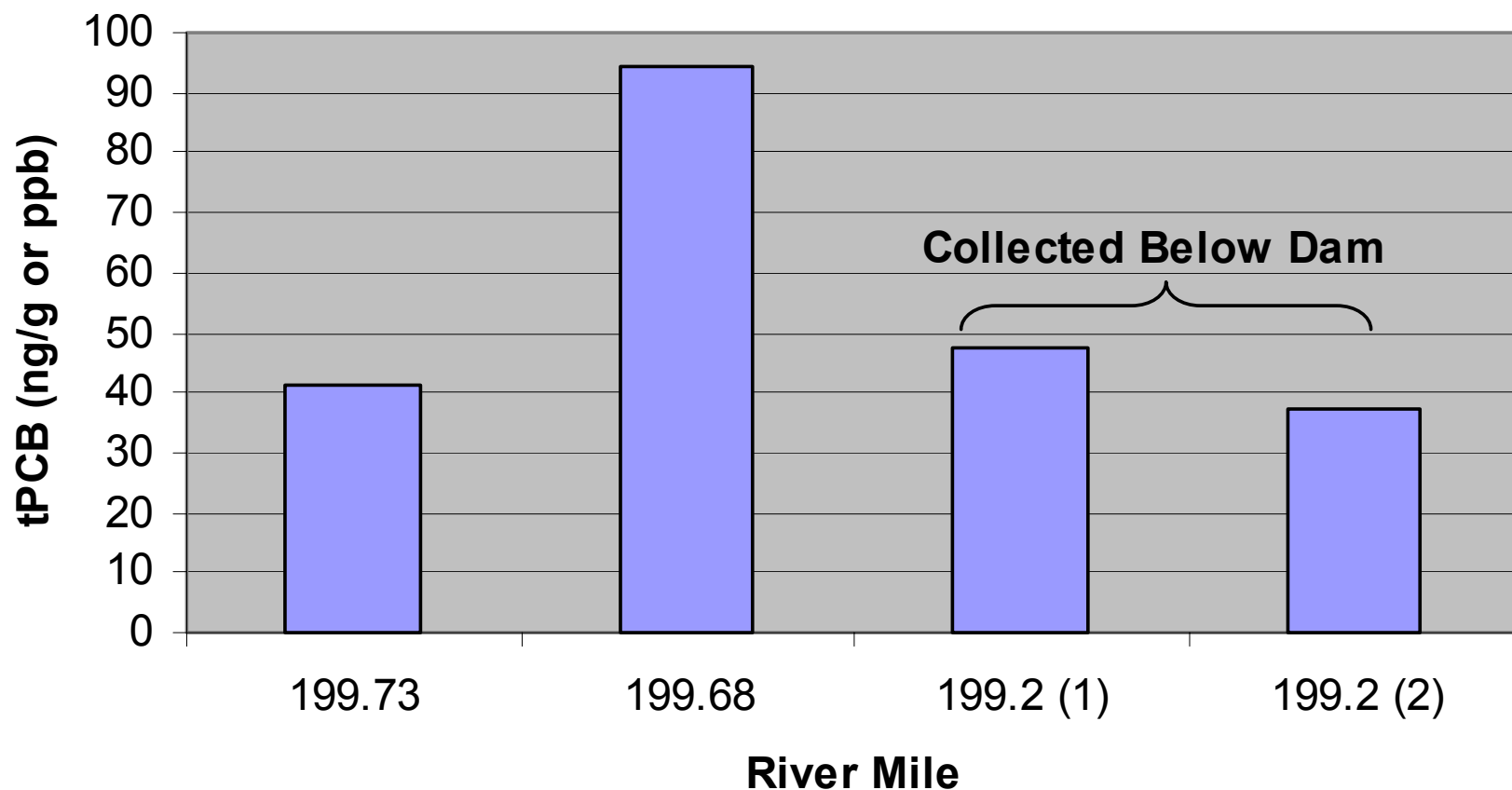
Effluent Results – Upper Roanoke

Facility	Concentration (pg/L)
Western VA Sewage Authority “Dry” condition	328
“Wet” condition	350
Steel Dynamics	1,085

PCB Homolog distribution from Effluent Collected at the Western VA Sewage Authority under Wet & Dry Flows



tPCB in sediment collected in the Roanoke River above and below Niagara Dam



Sources of PCBs Considered in the TMDL Development

- Point Sources (selected based on DEQ's Pt Source Monitoring Guidance)
 - Major/Minor Municipal and Industrial facilities
 - Industrial Stormwater/General Permits
 - MS4
- Contaminated Sites
- Non-Regulated Stormwater
- Tributaries
- Atmospheric deposition
- Sediment

Water Quality Criterion vs. Site Specific Endpoint

VA Criteria

**Consumption
Advisories
Fish Tissue
(ppb)**

50

**Water Quality
Criterion**

Total PCBs (ppb)

(Awaiting final approval from EPA)

0.00064

—WQC represents concentration in water column where accumulation of PCBs in fish should be at a level protective of fish tissue for consumption (humans)

PCB Exposure Pathways to Fish

- Intake through gills from water column
 - Basis of existing WQC (1980 EPA guidelines)
- Ingestion of prey
 - Biomagnification
- Ingestion of contaminated sediment
 - Indirect uptake from foraging
- Exposure through skin from contaminated sediment (e.g. catfish)

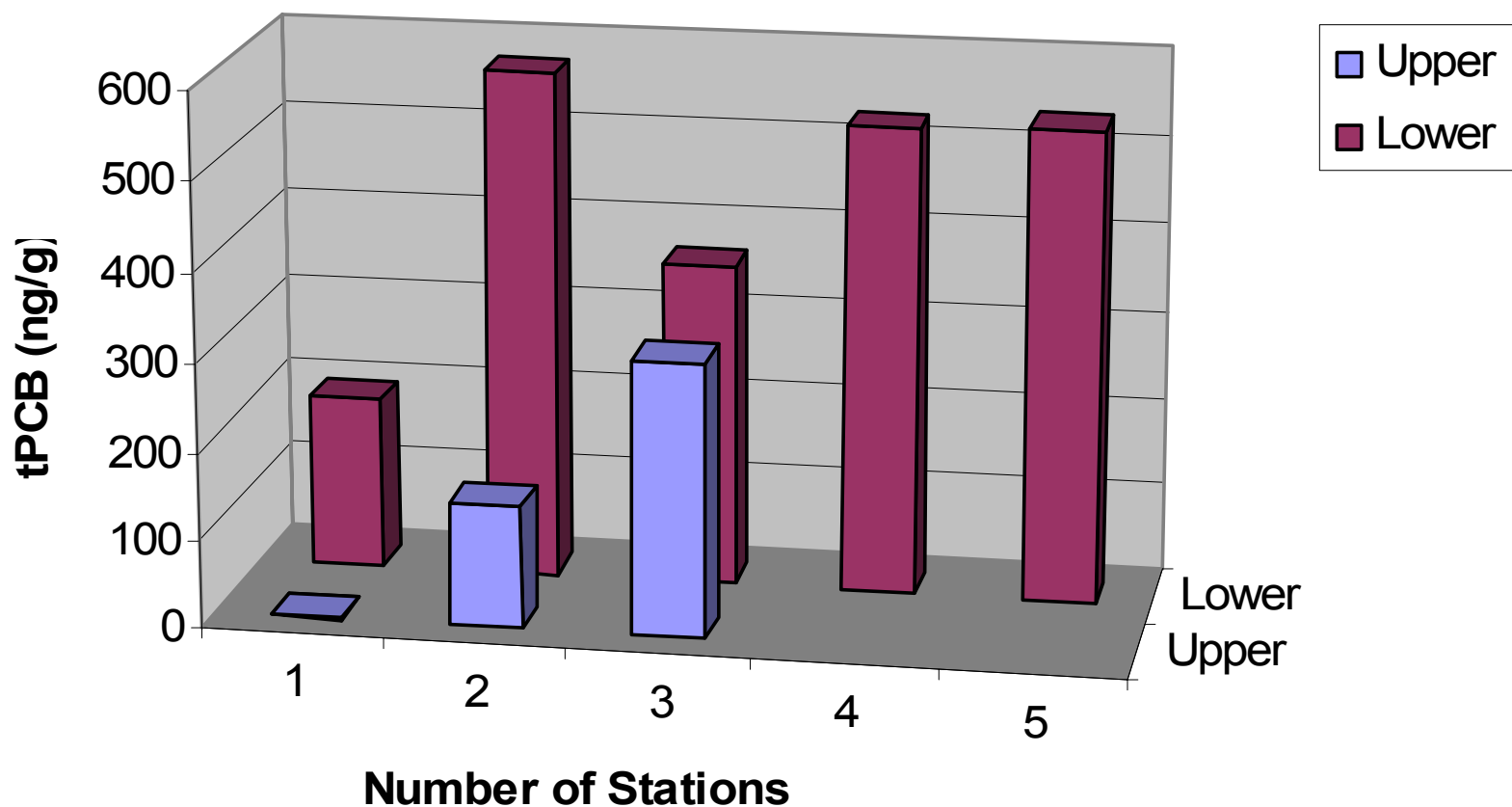
Site Specific PCB Endpoint

- TMDL Studies have shown criterion met instream but fish remain contaminated
- Supports development of a Site Specific Endpoint (BAF approach; 2000 EPA guidelines)
 - Accounts for localized conditions that affect bioaccumulation
 - Utilizes site specific water and fish data
 - Accounts for trophic transfer
 - Example: Potomac R. water endpoint (64 pg/L)
- Applies to TMDL development

Site Specific Endpoints

- Upper Roanoke River
 - Based on Carp (species included on VDH fish consumption advisory list)
 - Sample size adequate (n = 20)
 - Target water concentration = **360 pg/L**
- Lower Roanoke River
 - Based on Striped Bass (species included on VDH fish consumption advisory list)
 - Sample size more than adequate (n = 62)
 - Target water concentration = **150 pg/L**

Average tPCB Fish Tissue Concentrations in the Upper and Lower Roanoke River (2006)



Justification for Two PCB Endpoints

